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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	:	09/926,432	Confirmation No.: 3103
Applicant	:	Von Drach	
Filed	:	12/31/01	
TC/A.U.	:	1774	
Examiner	:	C. S. Thompson	
Docket No.	:	VOND3002JDB	
Customer No.	:	23364	

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DEC 0 4 2003
TC 1700

TRANSMITTAL ACCOMPANYING REQUEST FOR CONTINUED EXAMINATION AND PETITION FOR EXTENSION OF TIME

Did speak w/ Cynthia; she said keep finality

Commissioner for Patents
P.O. Box 1450
Alexandria, VA. 22202-3514

Sir:

Examiner Thompson informed the below-signed attorney during a telephone conversation on November 24, 2003, that she will speak to her supervisor concerning the propriety of the finality of the last office action (i.e., the office action dated July 28, 2003). The below signed attorney has been unable to obtain an answer from the examiner despite numerous phone calls made to her.

The accompanying request for continued examination is obviously unnecessary in the event that the examiner determines that the finality of the last office action should be withdrawn. However, applicant now finds it necessary to file a request for continued examination along with a petition for a one month extension of time. In view of the above, applicant reserves the right to a refund for the fees paid in connection with the accompanying request for continued examination and petition for an extension of time.

Date: November 26, 2003

Respectfully submitted,

Joseph DeBenedictis
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HANDOUT: Tue, 21 Sep 1999 08:38:02

REFINING AND PULP CHARACTERIZATION

Refining – mechanical treatment of pulp fibers to develop their optimum papermaking properties. Refining increases the strength of fiber to fiber bonds by increasing the surface area of the fibers and making the fibers more pliable to conform around each other, which increases the bonding surface area and leads to a denser sheet. Generally a refining is a trade-off between improving fiber to fiber bonding and decreasing the strength of individual fibers. Most strength properties of paper increase with pulp refining, since they rely on fiber to fiber bonding. The tear strength, which depends highly on the strength of the individual fibers, actually decreases with refining. Refining of pulp increases their flexibility and leads to denser paper. This means bulk, opacity, and porosity values decrease with refining.

Fiber Brushing - refining at high consistency with a relatively large distance between the refiner plates increases fiber-fiber interactions that are termed fiber brushing. This tends to roughen the fiber surface, with minimal fiber cutting for improved fiber-fiber bonding.

Fiber Cutting - Operating refiners at low consistencies with a minimal distance between the refiner plates increases fiber-bar contact, resulting in fiber cutting. This is desired with long-fiber pulps (redwood, cotton etc.) to increase the quality of formation on the paper machine. In most cases, however, it is desirable to minimize fiber
cutting to maintain high paper strength.

Drainage – is the ease of removing water from pulp fibers, either by gravity or mechanical means. CSF is a measure of drainage and a useful means for determining the level of refining.

Fibrillation – production of rough surfaces on fibers by mechanical action; refiners break the outer layer of fibers, i.e., the primary cell wall, causing the fibrils from the secondary cell wall to protrude from the fiber surfaces. For example, the surface area of kraft, softwood fibers is on the order of 1m2/g at 750 CSF, but it increases to about 5m2/g at 350 CSF.

Average fiber length – statistical average length of fibers in pulp. Fiber length is measured microscopically (number average), by classification with screens (weight average) or by optical scanners - Kajaani (number average). The coarseness of fibers has an important effect on many properties of paper. Coarseness is defined as the weight per unit length of fiber expressed as milligrams per 100 m.

Pulp used to be treated in beaters , such as the Hollander beater, but now refiners are used. The terms beating and refining are often used interchangeably, but refining is applicable to most modern equipment.

Canadian Standard Freeness, CSF – the CSF test was developed for use with groundwood pulps and was not intended for use with chemical pulps; nevertheless, it is the standard test for monitoring refining in North American mills. Refining decreases the pulp freeness, the rate at which water will drain through the pulp. Refined pulp, therefore, has a low freeness. A high drainage rate also means a high freeness. Obviously freeness is of utmost importance in the operation of a paper machine. A
low freeness means that the paper machine will have to operate relatively slowly, a condition that is usually in tolerable. There are other freeness tests that are used around the world. Perhaps the most common one is the Shopper Riegler test, which is similar in concept to the CSF test. CSF results depend on the temperature and consistency.

2.3.2.5. Production Processes

Raw material processing and fiber production in the wet and dry processes are very similar, frequently even identical.

Raw Material Processing. The wood used is predominantly roundwood, also partly debarked chips from sawmills or whole-tree chips. Pieces of bark are generally undesirable. They contain minerals that shorten the service life of refiner disks and processing tools, and impair surface quality.

Roundwood is generally debarked before chip production. This can be carried out by using ring or drum debarkers.

Chips are most frequently produced by using disk chippers or cylinder chopping machines. The cutting disk of the disk chipper, arranged vertically or diagonally, is fitted with 4–16 blades, depending on the size. The positions of the blades determine the dimensions of the chips.

Fine chips (<4-mm sieve mesh) and coarse chips (>40-mm sieve mesh) are separated from normal chips by sieving on flat or drum sifters. The fine chips are incinerated, and the coarse ones are cut up further in hammer or wing beater mills. The optimum chip size is 20–25 mm× 20 mm×5 mm.

To remove foreign material and mineral components, chips are washed before further processing. This is particularly important with whole-tree chips. Washing is carried out in specially designed plants with prewashers for separating coarse components and a screw drainer for separating fine mineral particles. The chips are then stored in reinforced concrete or metal silos. Storage acts as a buffer between chip and fiber production and at the same time allows the moisture distribution to become more uniform.

Fiber Production. The aim of defibration is to break up the previously chopped raw material as carefully as possible into individual fibers and bundles of fibers. This is carried out thermomechanically. The lignin-rich middle lamellae that bind the fibers are first softened by heat and steam. The fibers are then separated by mechanical abrasion. They are often broken in the process, giving fiber fragments. The anatomical nature of the fibers and their state after defibration are important for forming the fiber mat and for the properties of the board. This applies particularly to the wet process in which the freeness (draining behavior) and the type of matting are very important.

Thermal treatment of the chips before and during defibration causes part of the hemicelluloses to go into solution. Increasing the temperature and the length of the treatment period leads to increased softening of the interfiber bonding. In the wet process, this improves the natural adhesion between fibers during board production. At the same time, the sugar content of the wastewater and the energy consumption increase, so that a compromise between environmentally friendly and economic process design and board properties is usually aimed at.

Fiber production is energy intensive; it consumes more than half of the total process energy. Table (10) gives an overview of important current fiber production processes.

In the *Masonite process*, both the softening of fiber bonds and the separation of fibers are effected by steam. This technique is used exclusively in the United States by the Masonite company (wet process).

Refiners. In all other processes defibration is carried out by using grinding disks. Some defibrators operate at atmospheric and others at elevated pressure. Also, machines exist with only one rotating grinding disk (Sunds) or with two counterrotatory disks (Sprout-Bauer).

Refiners operating at atmospheric pressure have the disadvantages of high energy consumption

and moderate quality of the fibers produced.

The refiner now used predominantly, which operates under pressure, gives better results. The Asplund defibrator (Sunds) is a prototype. This makes use of the fact that from ca. 170 °C, separation of fibers in the middle lamella is considerably easier and is associated with a significant lowering of the energy consumption and an improvement in fiber quality.

In the defibration process (see Fig. (30)), washed chips are fed into the preheater through a conical opening using a screw feeder (c). The preheater (e) is usually a vertical, slightly conical pressure container, which is continuously charged with saturated steam at 150 – 180 °C. The steam heats the chips by condensation. Blowing steam out through the opening is hindered by the plug formed in it by the chips (d).

In 1 – 3 min the chips reach a conveyor screw (g) at the base of the preheater through which they are transferred to the grinding disks of the refiner (h), where defibration takes place under steam pressure. The necessary grinding power is ca. 200 kW per tonne of dry fiber.

The important parameters affecting the quality of the fiber material and the energy consumption are the residence time and vapor pressure in the preheater, throughput quantity, defibrating pressure, distance between grinding disks (0.1 – 0.4 mm), number of revolutions per minute, state of the grinding disk, nature of the raw material, and moisture level.

Defibration is tested by determining the degree of grinding or by fractionating the fiber material. The degree of grinding is a measure of the freeness of the fiber material and determined by means of the dewatering speed of a fiber suspension (standard freeness tester, defibrator-seconds, DS). In the wet process, higher degrees of grinding usually result in an improvement in board properties.

After defibration fibers are blown out through a pressure-regulated exit valve. From this stage onward the wet and dry processes differ and are described separately below.

Wet Process. A fiberboard production plant using the wet process is shown schematically in Figure (31). The fiber material is fed to silos (b) for mixing and adjusting concentration (4 – 6 %) or is further defibrated in disk refiners (f). For hard and semihard fiberboards a degree of grinding of 18 – 30 DS is aimed at, and for porous boards 42 – 70 DS [60].

A system of tanks and conveying devices is used for mixing, storing, and addition of adhesives and additives (see Section 2.3.2.4. Binders and Additives). A control panel connected to the system regulates concentration, temperature, and pH.

The fiber mat is formed on a sieve by drainage of water from the fiber suspension and subsequent sedimentation of the fibers. Mat formation was previously carried out as a batch process in tanks, but cylinder wet machines and conveyor sieve dewatering machines are predominantly used now. The main component of the latter is a continuously moving sieve. Fiber material is added through a headbox at a concentration of 1 – 2 % and is subsequently drained and compressed by means of a forming table, suction box, and wet pressing section. To improve the surface properties of the smooth side of the fiberboard, fiber material of higher quality can be applied to the mat on the forming table through a second headbox. After the wet press the thickness of the mat is 20 – 25 mm, which gives a final thickness of 3 – 5 mm. The mat is then separated into individual sections corresponding to the pressed board format of the hot press.

In the production of *softboard* or *S2S hardboard* by the wet process, the drained fiber mats are dried in single- or multideck dryers at 150 – 170 °C from moisture levels of 100 – 120 % to 1 – 4 %.

To prevent dried boards from catching fire during subsequent storage, they are cooled

immediately after drying by spraying with water and aspiration of ambient air.

S1S board is further dewatered in hydraulic multi-daylight presses by hot pressing using an established pressure–time program, compressed, and strengthened by curing the binders that are naturally present or have been added. For S1S, use of a draining sieve is necessary to remove the large quantities of water. For hardboard the pressing time is generally 2.0–3.5 min/mm at a pressing temperature of 180–200 °C. A typical pressing diagram consists of three phases, the compression and first high-pressure stage, drying, and the second high-pressure stage.

An improvement in the properties of fiberboard can be effected by thermal aftertreatment in chambers or continuously in tunnels or by impregnating with drying oils (see Section 2.3.2.4. Binders and Additives). Treatment results in a more uniform moisture distribution in the board as well as better dimensional stability.

Dry Process. The production of MDF is shown schematically in Figure (32). After defibration (g) the fibers pass down a blow line in which glue (see Section 2.3.2.4. Binders and Additives) is added and then reach the fiber dryer (i). Alternatively, they can be blown directly into the fiber dryer (i) by making use of the vapor pressure present in the refiner. In this case they are subsequently glue-blended in high-speed centrifugal machines, as in particle board production. In almost all plants, glue blending occurs before drying, thus avoiding spots of adhesive on the board surface that impair its quality. Paraffin added to improve hydrophobic properties is generally charged in the molten state to the lower conveyor screw of the refiner.

Tube dryers are now used exclusively for drying the fibers. They are mostly two-stage dryers with tube lengths of 80–100 m and diameters of 1.3–1.6 m. The air temperature at the entry is 140–170 °C. Because of the high air speed (ca. 30 m/s) and the small dimensions of the fibers, the drying time is only a few seconds [61]. The moisture level of the fibers is adjusted to 9–11 % by regulating the exit temperature of the dryer.

The fibers reach the forming station (m) via cyclones and fiber hoppers (j). The fiber mat is formed either mechanically by using a snowfall felter or pneumatically by using a pendistor on a vacuum screen conveyor.

The uniformity of distribution of the fiber material over the surface of the screen significantly affects fiberboard properties.

The mat coming out of the forming station has a very low bulk density and contains a large quantity of air, which must be removed before hot pressing. To decrease the size of the press opening, shorten the closing times of the hot press, and improve the transportability of the mat and the surface quality of the finished board, the mat is precompressed in continuously operating belt prepresses. Mat density is thus doubled or trebled.

Hot pressing of the fiber mat occurs either batchwise on multi-daylight presses with preliminary separation into mat sheets or, as is now increasingly common, continuously on double-belt presses or calenders for thin boards (up to 8-mm thickness). The presses are the same as those used for particle board production (see Section 2.3.1.5. Production). To heat the fiber mat more rapidly and shorten the pressing time, the fiber mat is often subjected to high-frequency preheating before entering the hot press. Pressure control in MDF production differs from that in particle board production. Figure (33) gives an example of the pressure program.

The bulk density profile (perpendicular to the board thickness) and thus the properties of the board can be widely varied through the type of compression and the temperature control. High compression in the outer zones and as uniform a density as possible in the inner zones are aimed at (see Section 2.3.2.6. Properties, Testing, and Uses).

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G. Gran, *Holztechnologie* **28** (1987) 143–146.

2.1.2. Characteristics Required of Mechanical Pulps

About 90 % of the mechanical pulp produced is used to make graphic papers, such as newsprint; uncoated and coated magazine papers, e.g., SC (super calendered); and LWC (light weight coated) papers [251]. The desired properties of mechanical pulps, used for graphic papers, are as follows:

1) The mechanical pulp should contribute substantially to the structural strength of the paper. Newsprint, for example, may contain more than 80 % mechanical pulp.
2) The printability of the paper is mainly determined by the quality of the mechanical pulp.
3) Since graphic paper is usually printed on both sides, a very low show-through and strike-through of the printing ink is very important. In offset printing, the surface of the paper should have a high picking resistance and be free of dust.
4) The drainage ability (freeness) of mechanical pulp has to be high to allow the paper machines to be operated at high speeds (ca. 1400 m/min). Furthermore, the paper has to be able to cope with the stresses within the printing machines.

The technological data of mechanical pulp is determined by means of standardized test methods. The United States and its neighbors follow the TAPPI regulations [252], the Scandinavian countries use the Scan methods [253], and Germany and its neighbors, the Zellcheming regulations [254].

Although the methods used vary and the results are thus not directly comparable, all standards require determination of the following mechanical pulp properties:

1) Drainage characteristics (e.g., freeness)
2) Stability properties such as tensile strength tearing strength, and picking resistance
3) Optical properties such as brightness and opacity
4) The quantitative composition with respect to the portions of long fibers, fiber fragments, and fines as well as the size of the shives

Furthermore, proof printing and other tests provide information about the suitability of a mechanical pulp.

All in all, the test methods in question permit adequate assessment of the mechanical pulp and are essential for mechanical pulp production.

⇨ Continued ...

[251]
"Holzstoff—Halbstoff mit Zukunft," *Papier (Darmstadt)* **37** (1983) no. 10 A, V 11.

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American National Standards, Tappi, Atlanta 1989.

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